Usability, Affordance, and Usability Principles

Visual affordances and constraints

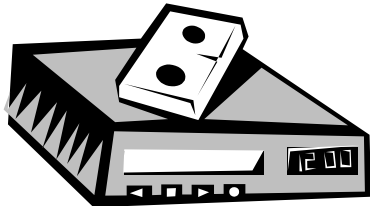
Conceptual models

Causality and other mappings

The principle of feedback

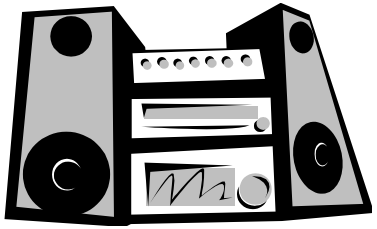
Constraints

Daily Challenges



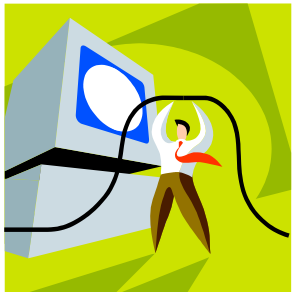
How many of you can use all the functionality in your

- VCR
- Digital watch
- Copy machine
- Stereo system
- Plumbing fixtures

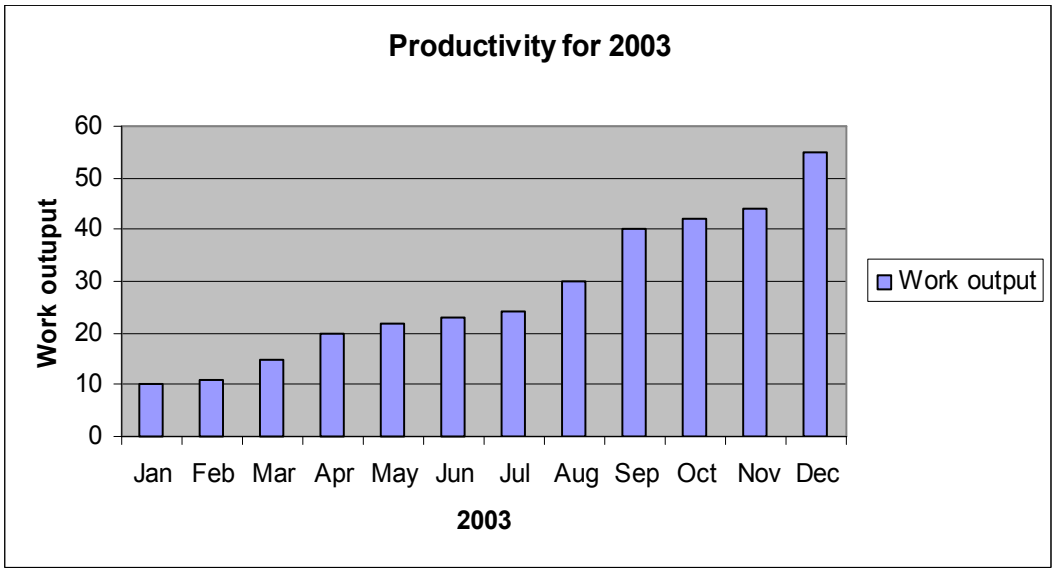


What Is Usability?

User satisfaction



Efficiency and effectiveness (user tasks)



Importance Of Usability: Cost Of Using A Computer

Costs from a technical perspective

- Hardware costs
- Software costs

Costs from the user's perspective (personware)

- Training costs
- Daily usage

Usability goals

Effective to use

Efficient to use

Safe to use

Have good utility

Easy to learn

Easy to remember how to use

Fun Examples

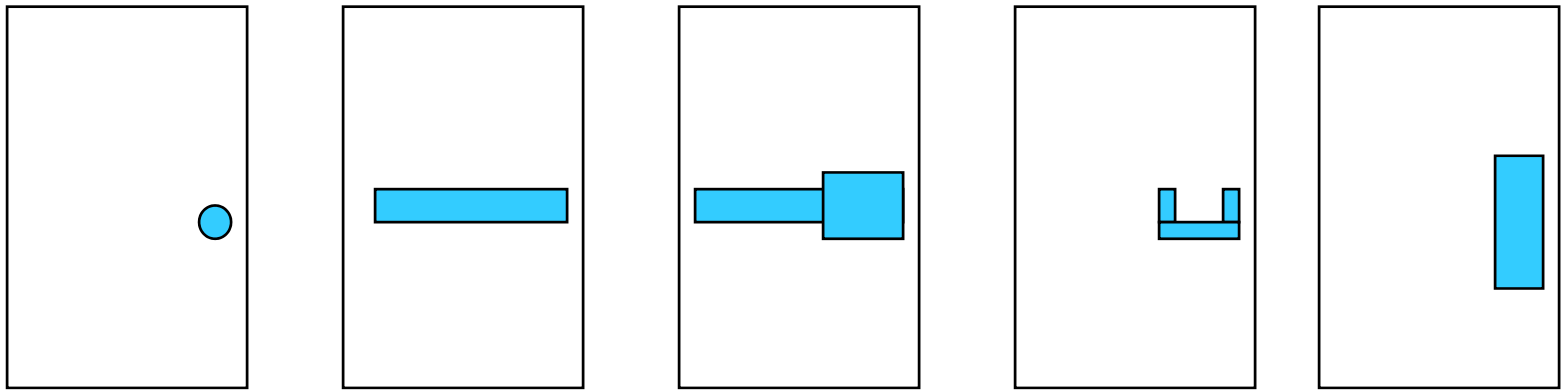
Leitz slide projector

- To move forward, short press
- To move backward, long press

What happens when you get frustrated?

Fun Examples

Doors

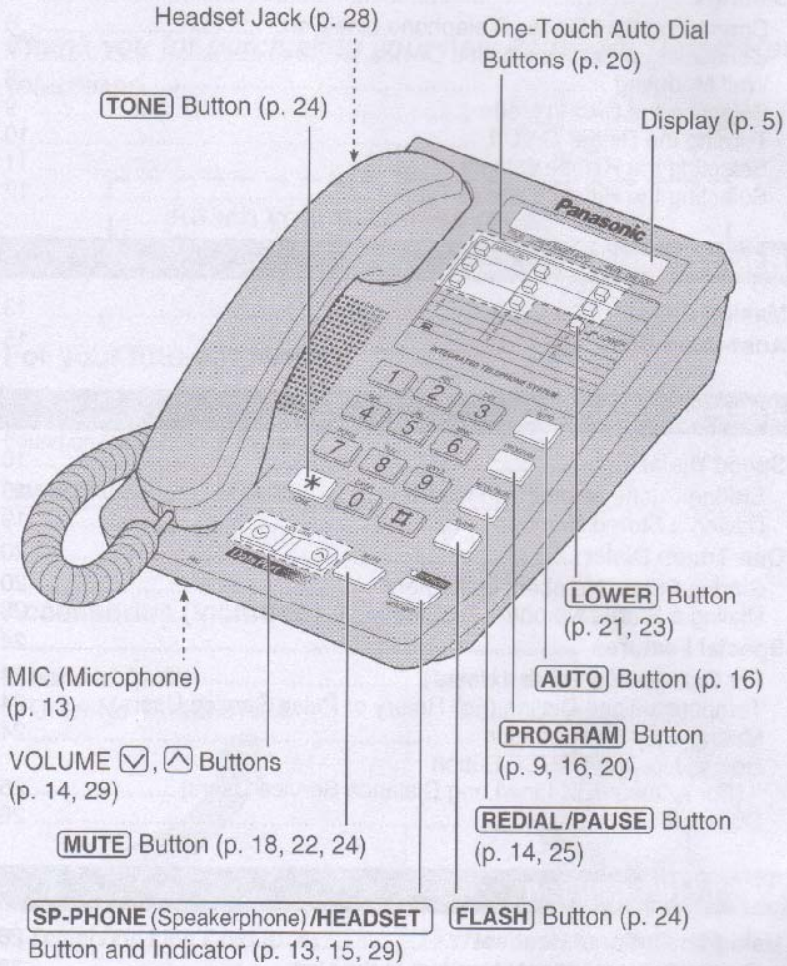


Fun Examples

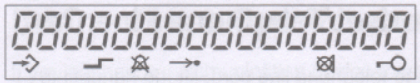
Phones

How do you
- transfer a call
- change volume
- store a number
- ...

Location of Controls



Display



(This display shows all of the possible configurations.)

0:15-30	During a conversation, the call duration is displayed. (Example: 15 minutes, 30 seconds)
→	The unit is in the programming mode (p. 9, 16, 20).
→•	The AUTO button was pressed while dialing or storing phone numbers for the Speed Dialer (p. 16, 19).
⌐	The LOWER button was pressed (p. 21, 23).
🔕	The ringer is set to OFF (p. 10).
⊠	The MUTE button was pressed during a conversation (p. 24).
⊸	The dial lock mode is set. To cancel the mode, see page 27.
F	The FLASH button was pressed while storing phone numbers.
P	The PAUSE button was pressed while dialing or storing phone numbers.
ϟ	You pressed ✳ while dialing or storing phone numbers in the TONE mode.
=	You pressed # while dialing or storing phone numbers in the TONE mode.
O	While storing a phone number in an UPPER memory location for the One-Touch Dialer, "O" will appear when you press a one-touch auto dial button (p. 20).
o	While storing a phone number in a LOWER memory location for the One-Touch Dialer, "o" will appear when you press a one-touch auto dial button (p. 21).
C-J	The MUTE button was pressed as a secret button while storing phone numbers (p. 18, 22).
_	While programming function items, such as the dialing mode, "_" will flash as a cursor.

Changing Ringer Volume

Press “Program”

Press “6”

Set volume

- Low - Press “1”
- Medium - Press “2”
- High - Press “3”

Press “Program”

Important Concepts

Affordances

Visibility

Conceptual models

Mapping

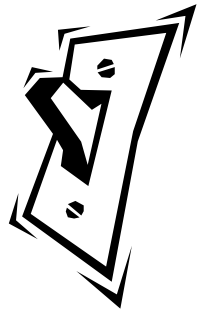
Feedback

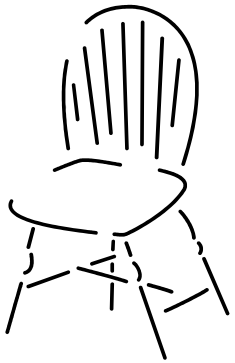
Constraints

Visual Affordances

How something looks indicates how it's can be used

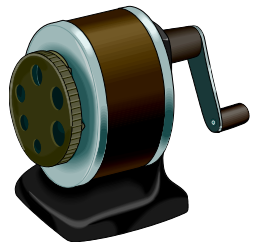
- Chair for sitting
- Table for placing things on
- Knobs for turning
- Slots for inserting things into
- Buttons for pushing





Complex things may need explaining, but simple things should not

- When simple things need pictures, labels, instructions, then design has failed
- Their usage should be obvious based upon their appearance



Visual Affordances: Computer Audio

Uses a familiar idiom and metaphor

Sliders for sliding

Buttons for pressing (Is this a button?)

Dials for turning

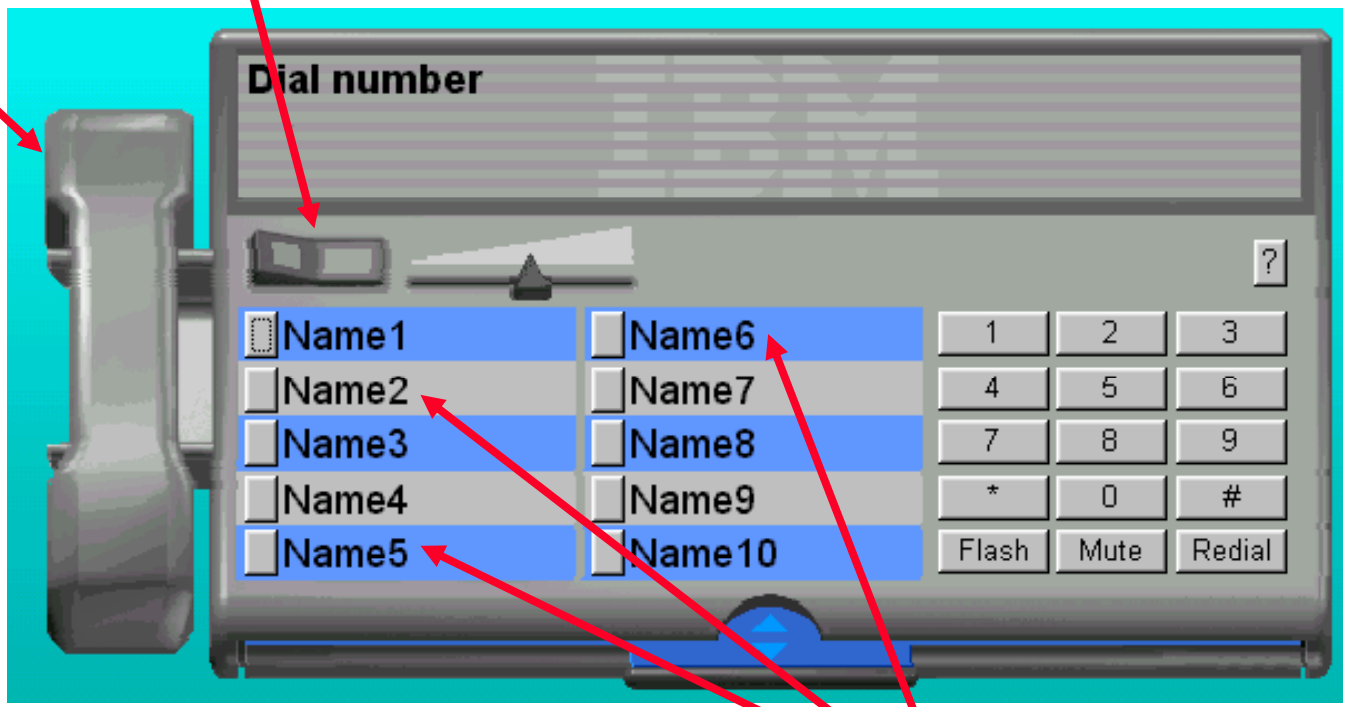
What's this button do?

Visual Affordances: Telephony

Is this a graphic or a control?

A button is for pressing, but what does this one do?

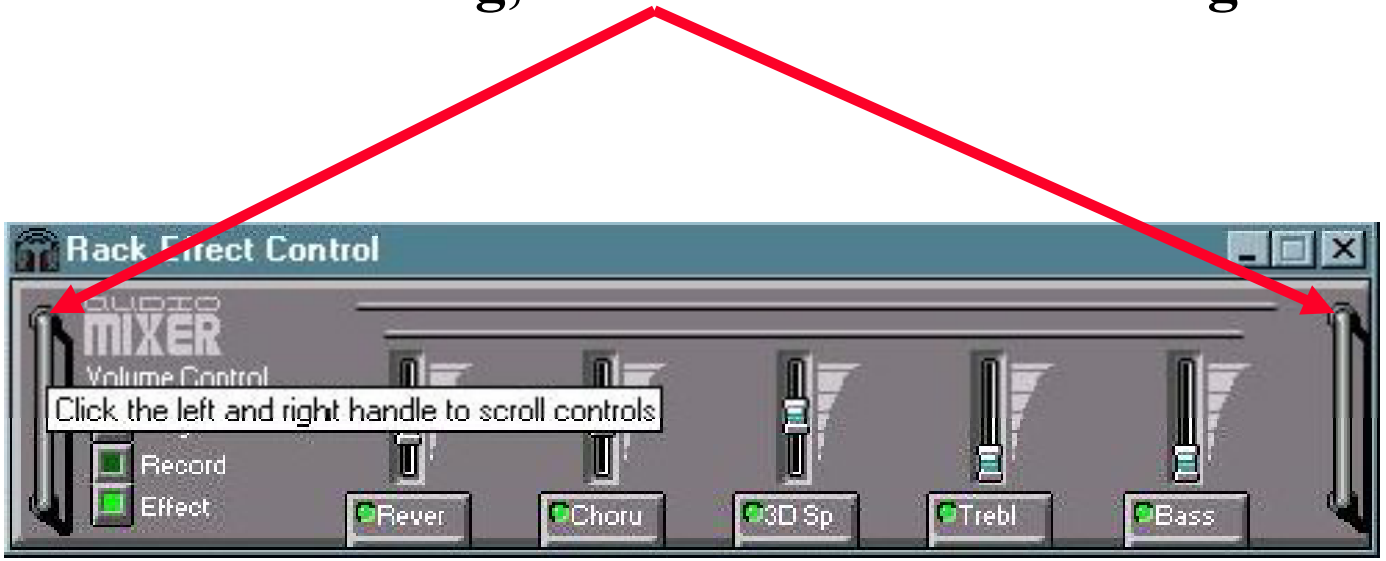
Visual affordances for window controls are missing!



Text is for editing, but you can't do that here

Visual Affordances: Multi-Media

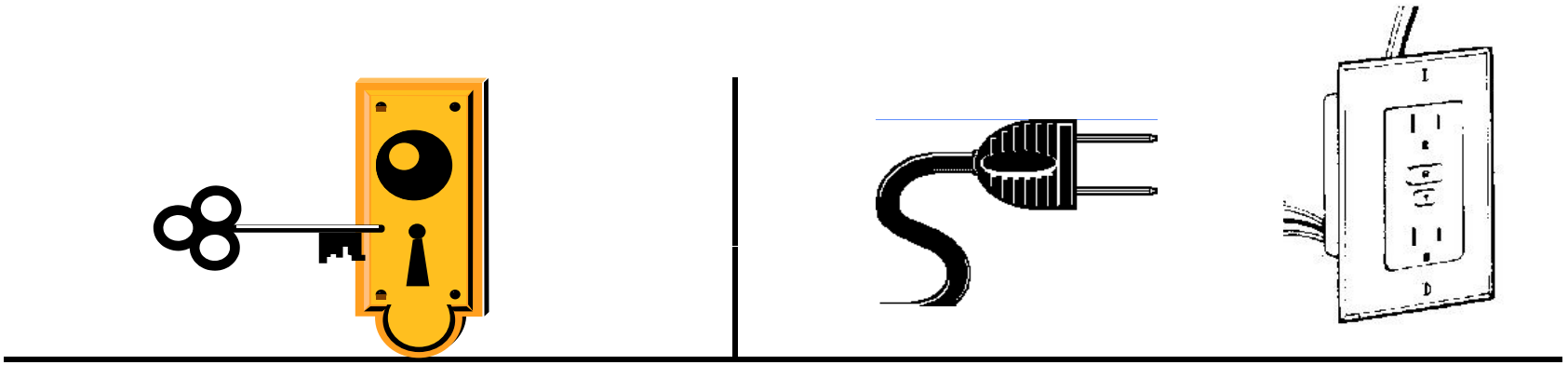
Handles are for lifting, but these are for scrolling

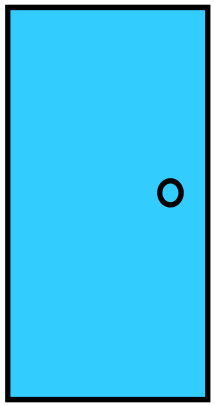


From *AudioRack 32*, a multimedia application

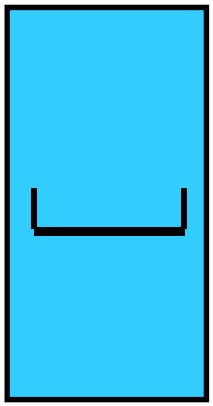
Visual Constraints

Limitations on the actions possible which are perceived from an object's appearance

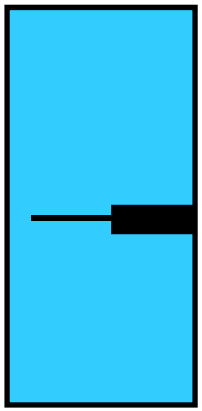




Push or pull?

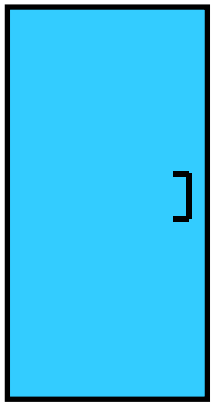


Which side?



Push or pull?

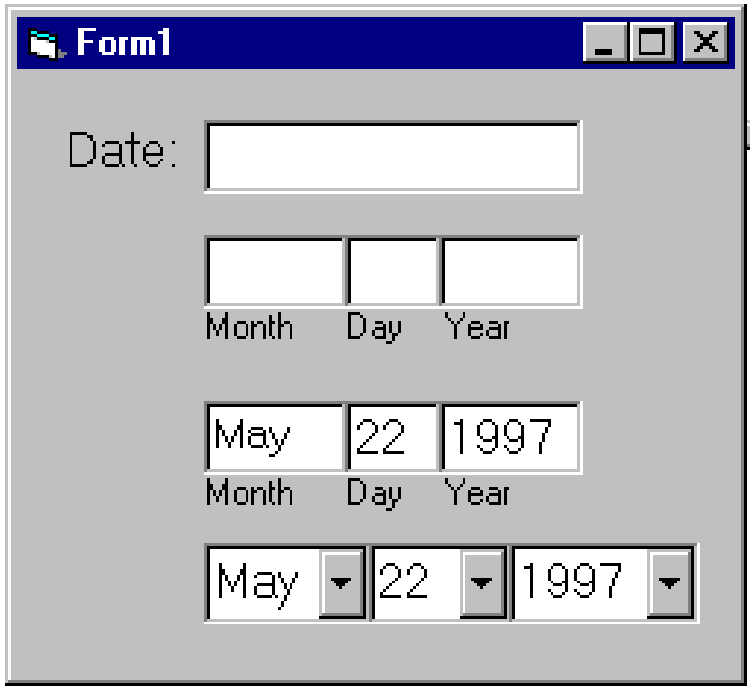
Which side?

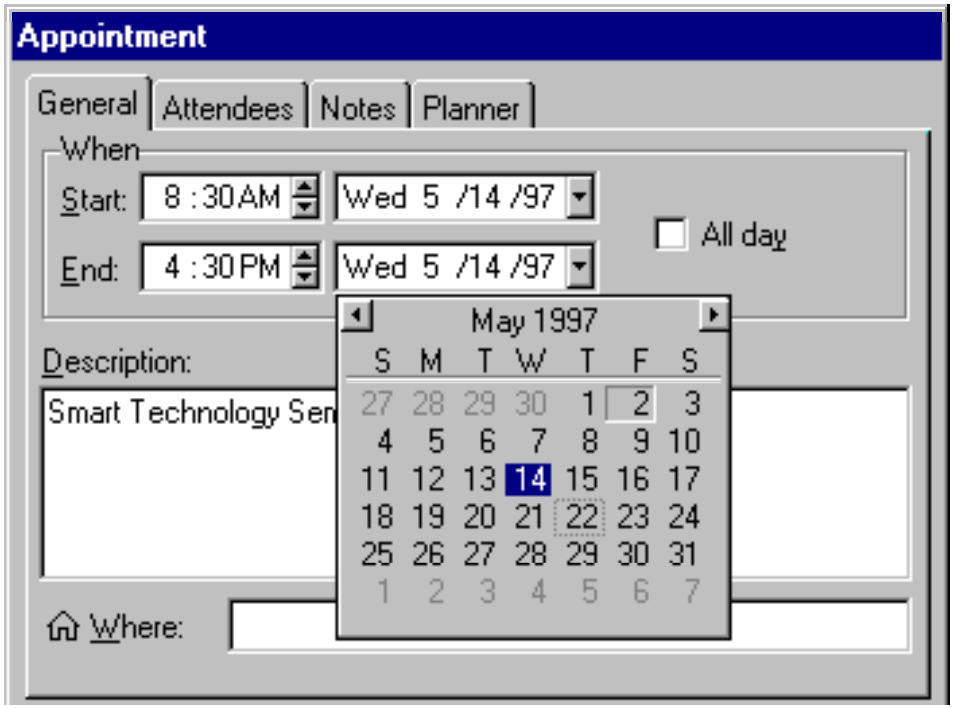


Push or pull?

Which side?

Visual Constraints: Calendar Controls





Visibility

When functionality is hidden, problems in use occur

- Occurs when number of functions is greater than number of controls

When capabilities are visible, it does not require memory of how to use

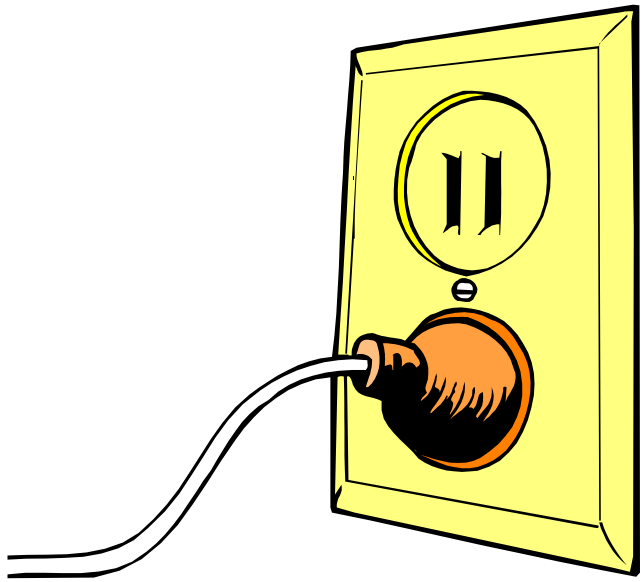
- Remind person how to use something

Make things visible

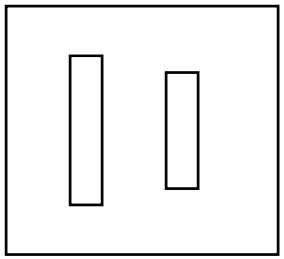
By looking, the user can tell the state of the device and the alternatives for action.

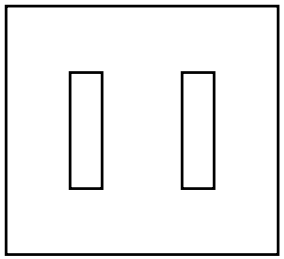
Simple Example

Electric plugs



What if both sides were “big” and you had to remember which side the “small” one went into?





Simple Example

Bathroom faucets

- Two functions
  - Hot/cold
  - Pressure

Bathroom Faucets 1

Can you figure out how to use it?

Are two functions clear and independent?

Bathroom Faucets 2

Can you figure out how to use it?

Are two functions clear and independent?

Bathroom Faucets 3

Can you figure out how to use it?

Are two functions clear and independent?

Visibility

- **This is a control panel for an elevator.**
- **How does it work?**
- **Push a button for the floor you want?**

- **Nothing happens. Push any other button? Still nothing. What do you need to do?**

It is not visible as to what to do!

From:
www.baddesigns.com

Visibility

…you need to insert your room card in the slot by the buttons to get the elevator to work!

How would you make this action more visible?

- **make the card reader more obvious**
- **provide an auditory message, that says what to do (which language?)**
- **provide a big label next to the card reader that flashes when someone enters**

- **make relevant parts visible**
- **make what has to be done obvious**

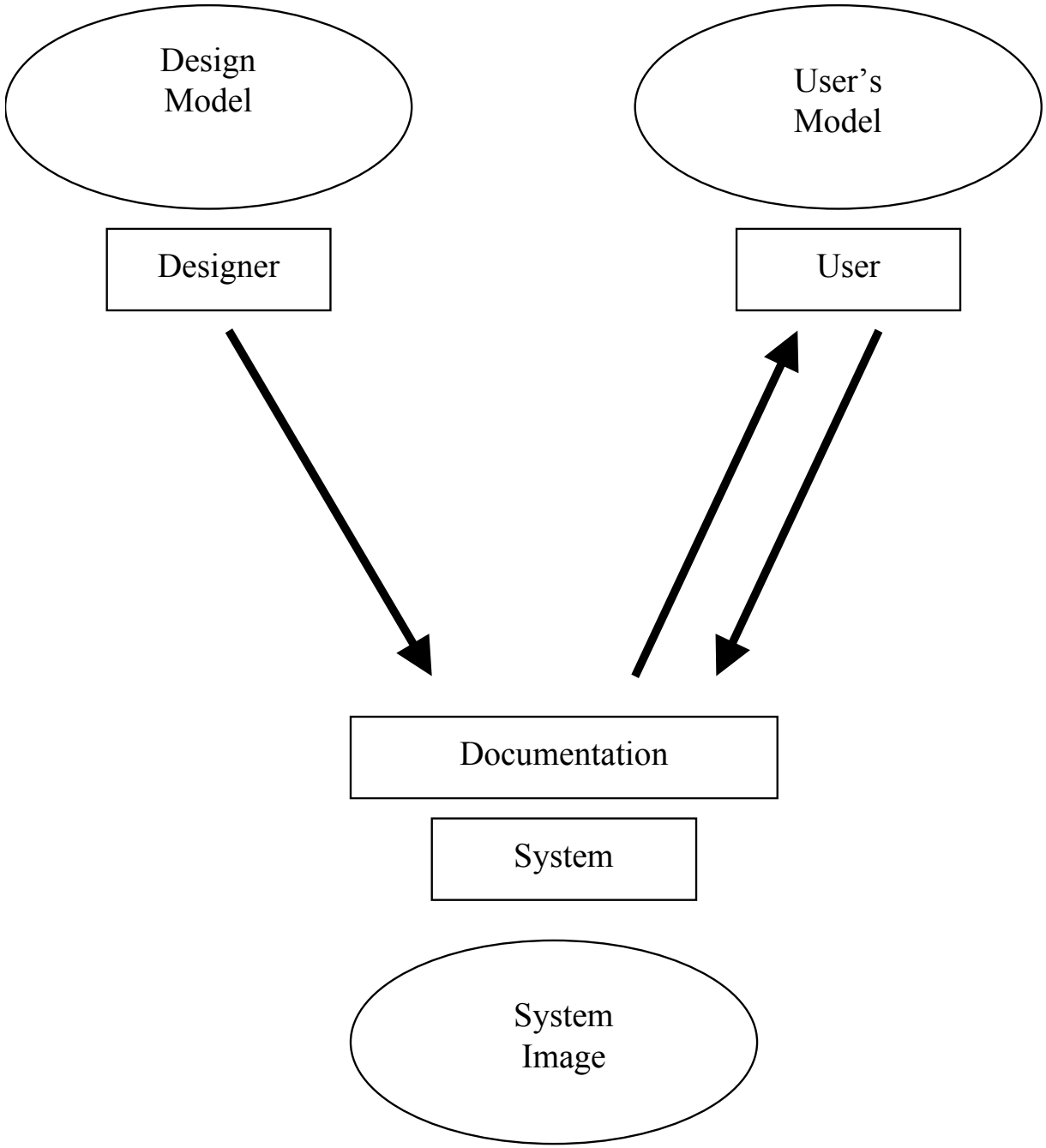
Visibility


PUSH TO
START
Premium
Silver
93
89
87
PRESS BUTTON FOR SERVICE

Provide a good conceptual model

A conceptual model allows the user to simulate the operation of the device.

A good conceptual model allows the user to predict the effects of their actions.


Design
Model
User's
Model
Designer
User
Documentation
System
System
Image

Conceptual Models

People have "mental models" of how things work

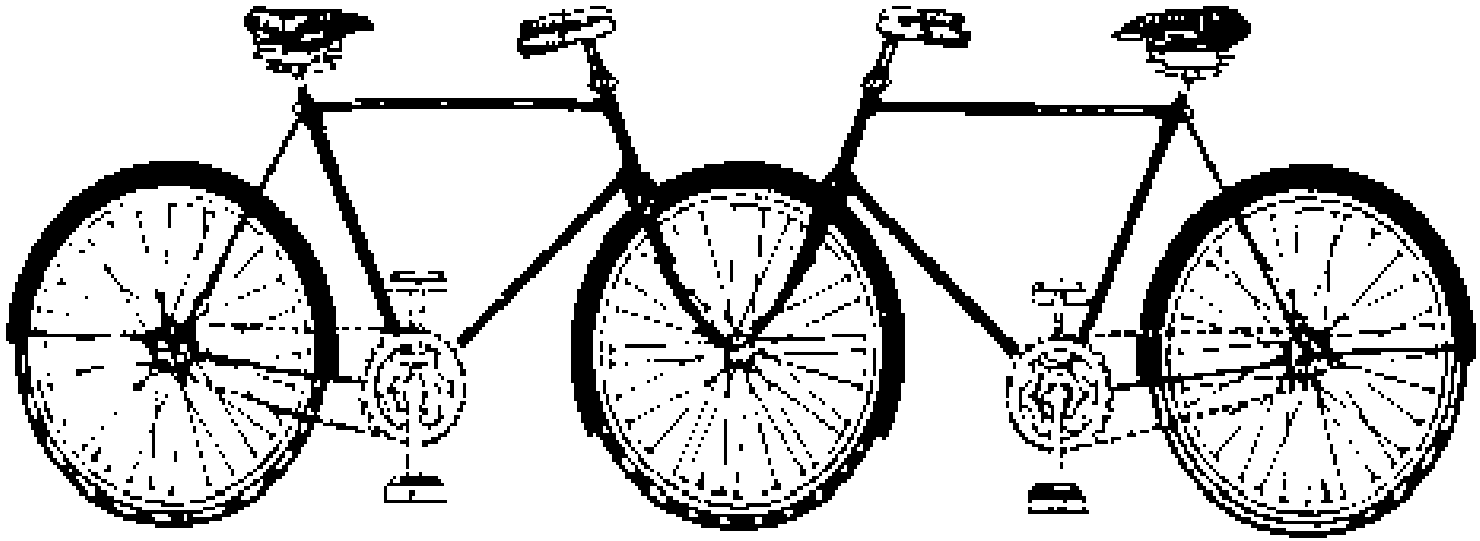
Conceptual models built from:

- Affordances and constraints
- Mappings and causality
- Transfer effects
- Population stereotypes/cultural standards
- Instructions
- Interactions

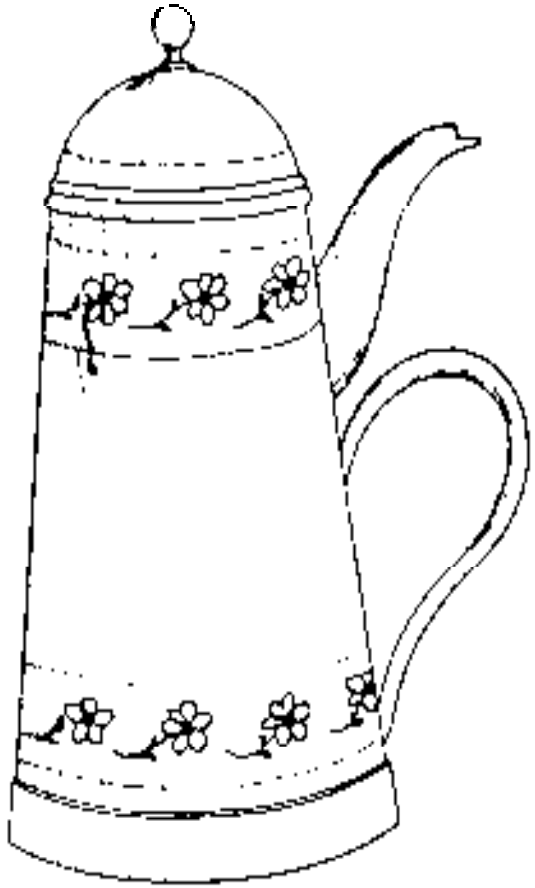
Models may be wrong, particularly if the above attributes are misleading

Models allow people to mentally simulate operation of device

Conceptual Models



Conceptual Models



Designing A Good Conceptual Model

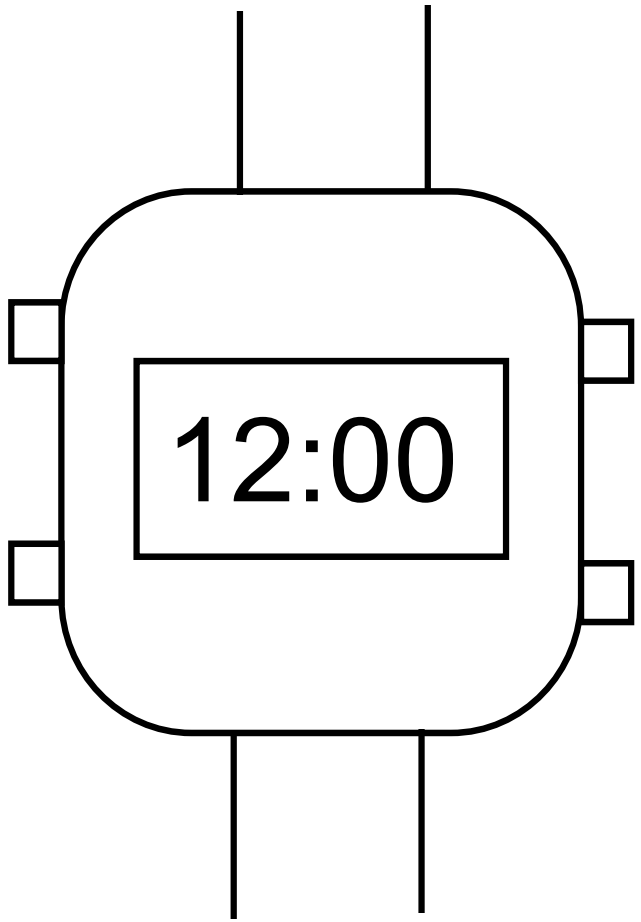
Communicate model through visual image

- Visible affordances and constraints
- Clear causality of interactions
- Consider cultural idioms, transfer effects
- Instructions augment visuals

Together all these things indicate what can be done and how to do it

An Example Of Good Design: Scissors

Example Of A Bad Design: Digital Watches



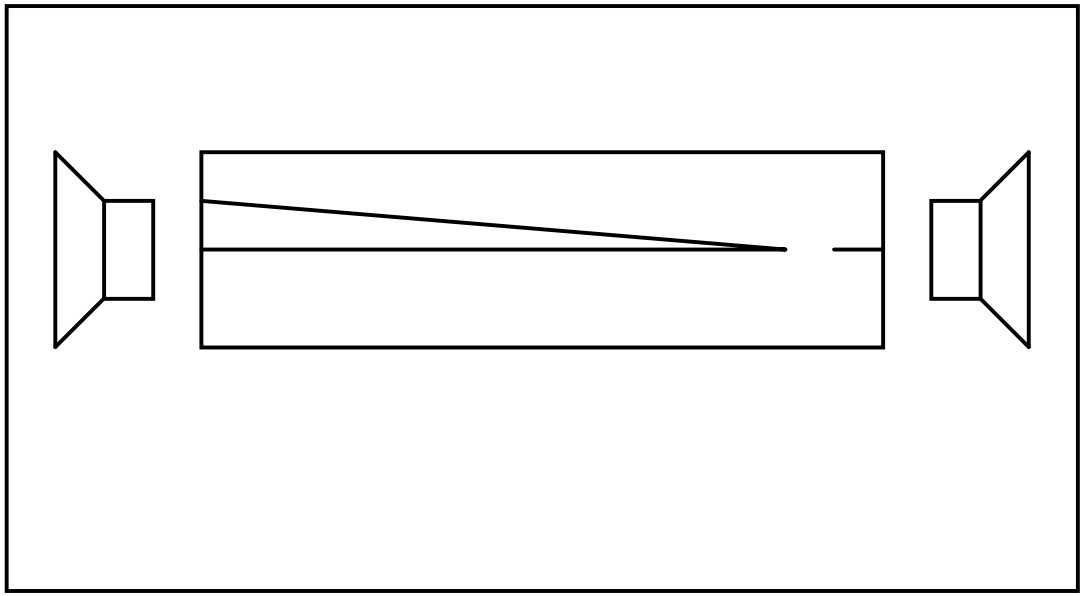
The Principle of Mapping

The relationship between two things

Natural mapping

- Physical analogies
- Cultural standards

Car speaker control



Good mappings

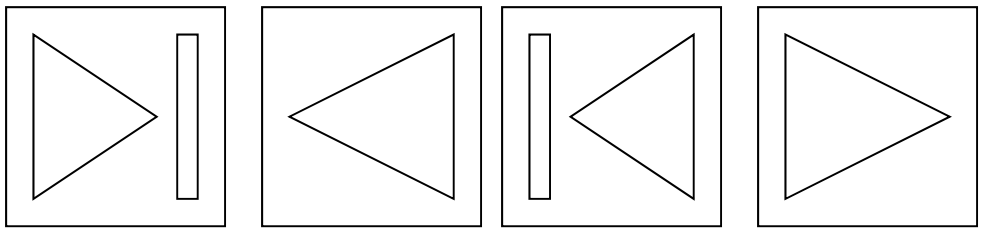
It is possible to determine the relationships between:

- Actions and results
- Controls and their effects
- The system state and what is visible

Mapping

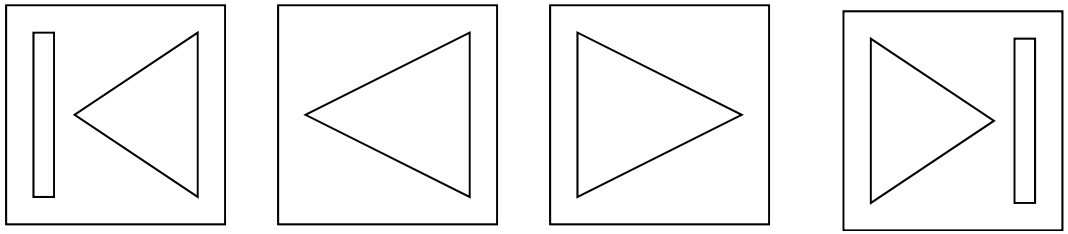
Relationship between controls and their movements and the results in the world

Why is this a poor mapping of control buttons?



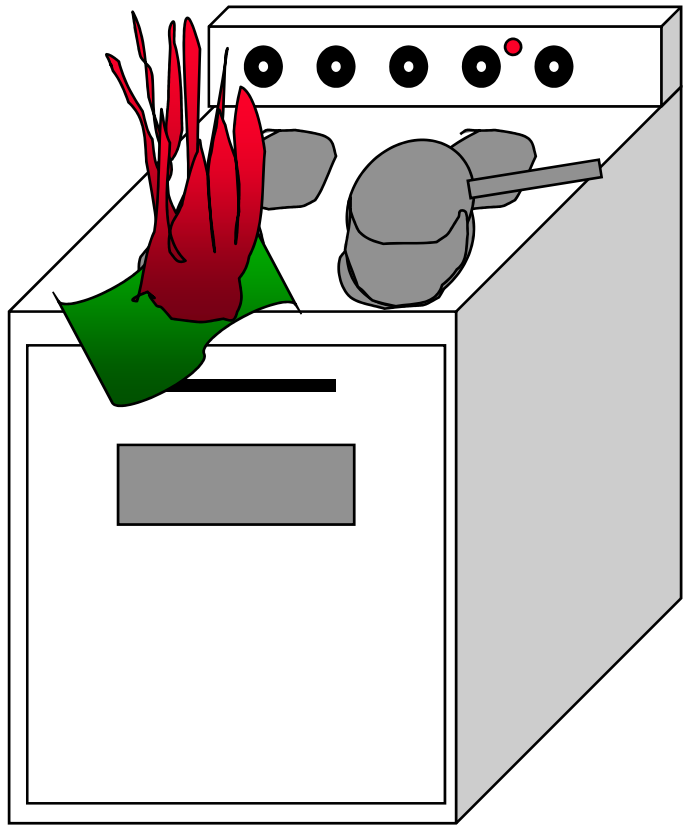
Mapping

Why is this a better mapping?

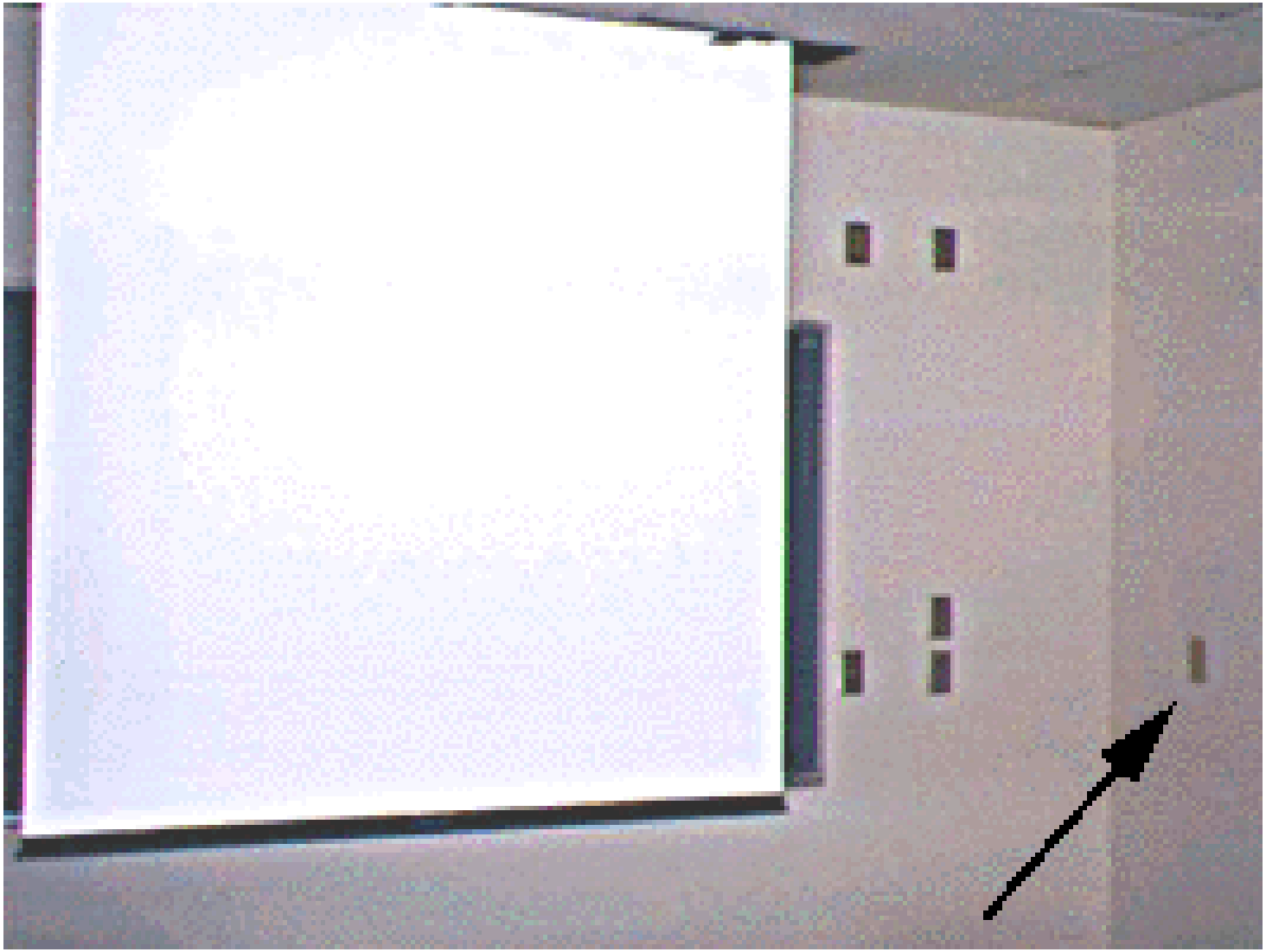


The control buttons are mapped better onto the sequence of actions of fast rewind, rewind, play and fast forward

Mappings



Guess Which Switch Controls The Screen?



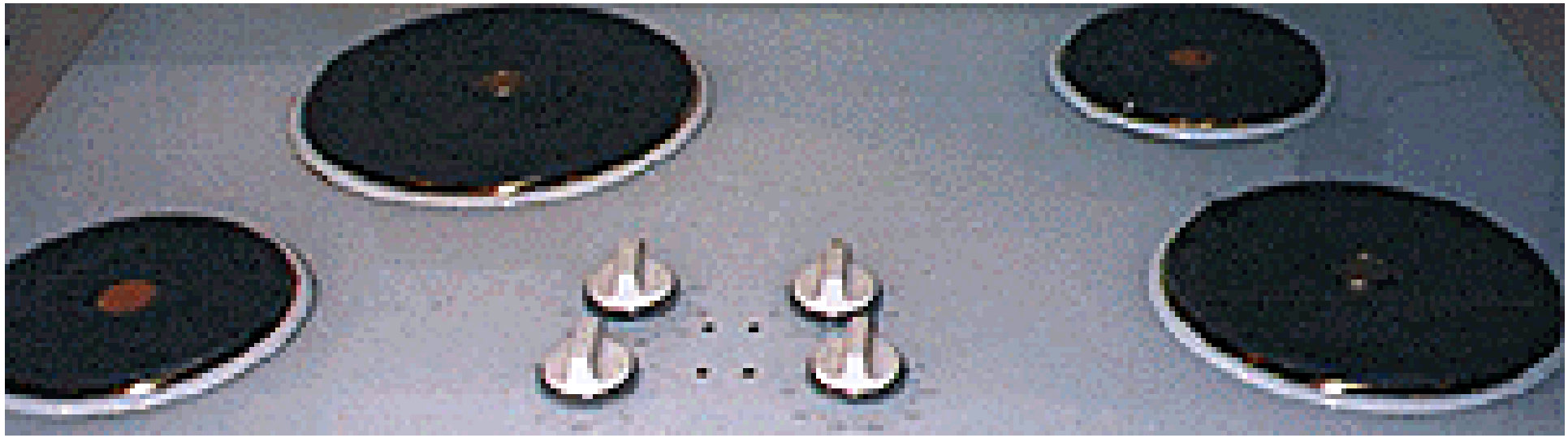
How Do You Play The CD?

Mappings

Mappings


OFF
OFF
OFF
OFF
OFF
OFF
OFF
HI
LO
HI
LO
HI
LO
HI
LO
HI
LO
250
100
200
150
ON
200 230 260
400 450 500
OVEN
HOTPLATES
GRILL
Centenary

Mappings

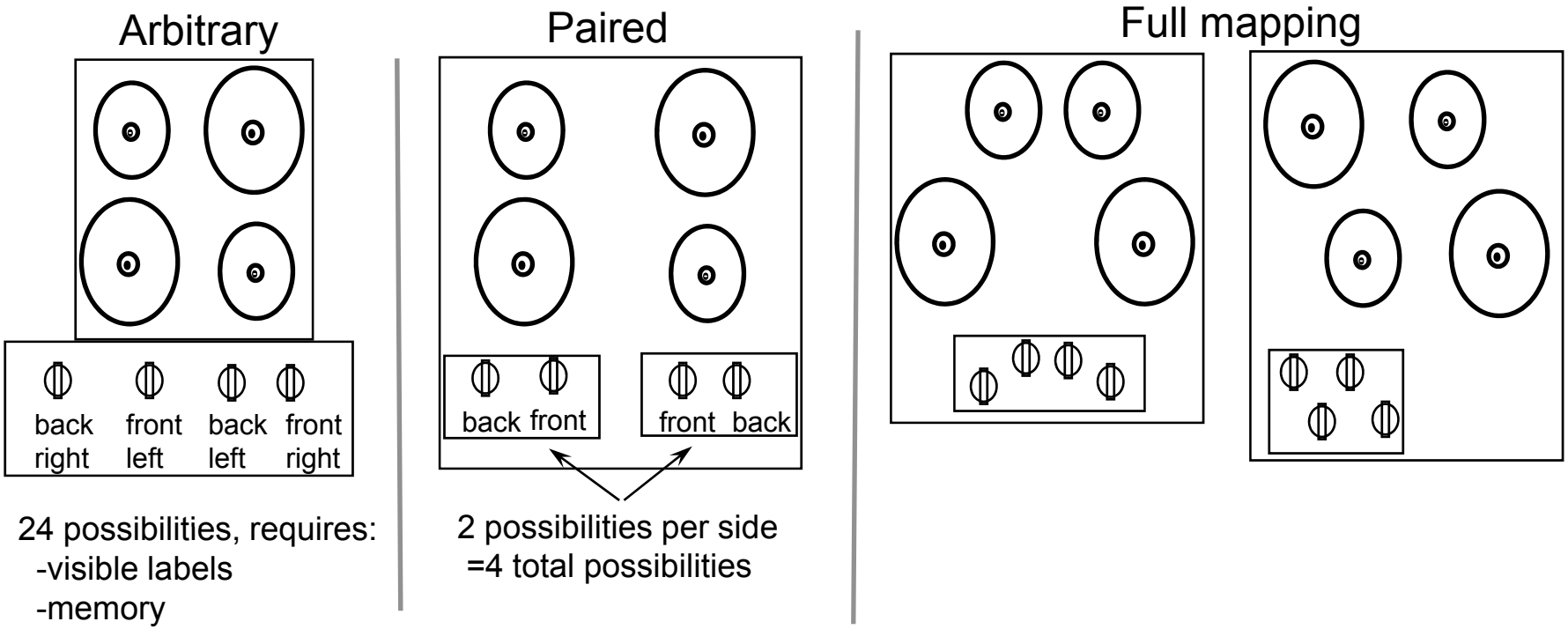


From www.baddesigns.com

Mappings

The set of possible relations between objects:

- The relation between the control and what is being controlled e.g., relationship between the burners and the mimic diagrams on a stove
- Cause and effect relationships e.g., turn the car's steering wheel right and the car goes right.

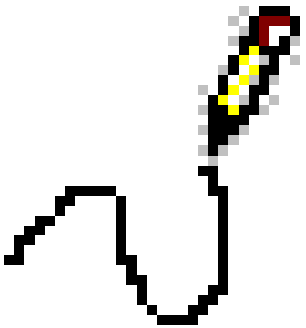


Mappings: Drawing Tools

Cursor re-enforces selection of current item

Only active palette items fully visible

Depressed button indicates currently mapped item



The Principle of Feedback

Sending back information to the user on what has been done.

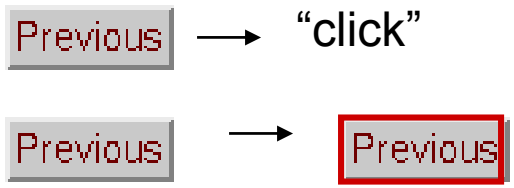
The user should receive full and continuous feedback about results of actions.

Feedback

Sending information back to the user about what has been done

Includes sound, highlighting, animation and combinations of these

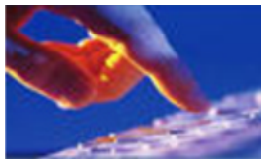
- e.g. when screen button clicked on provides sound or red highlight feedback:



Causality

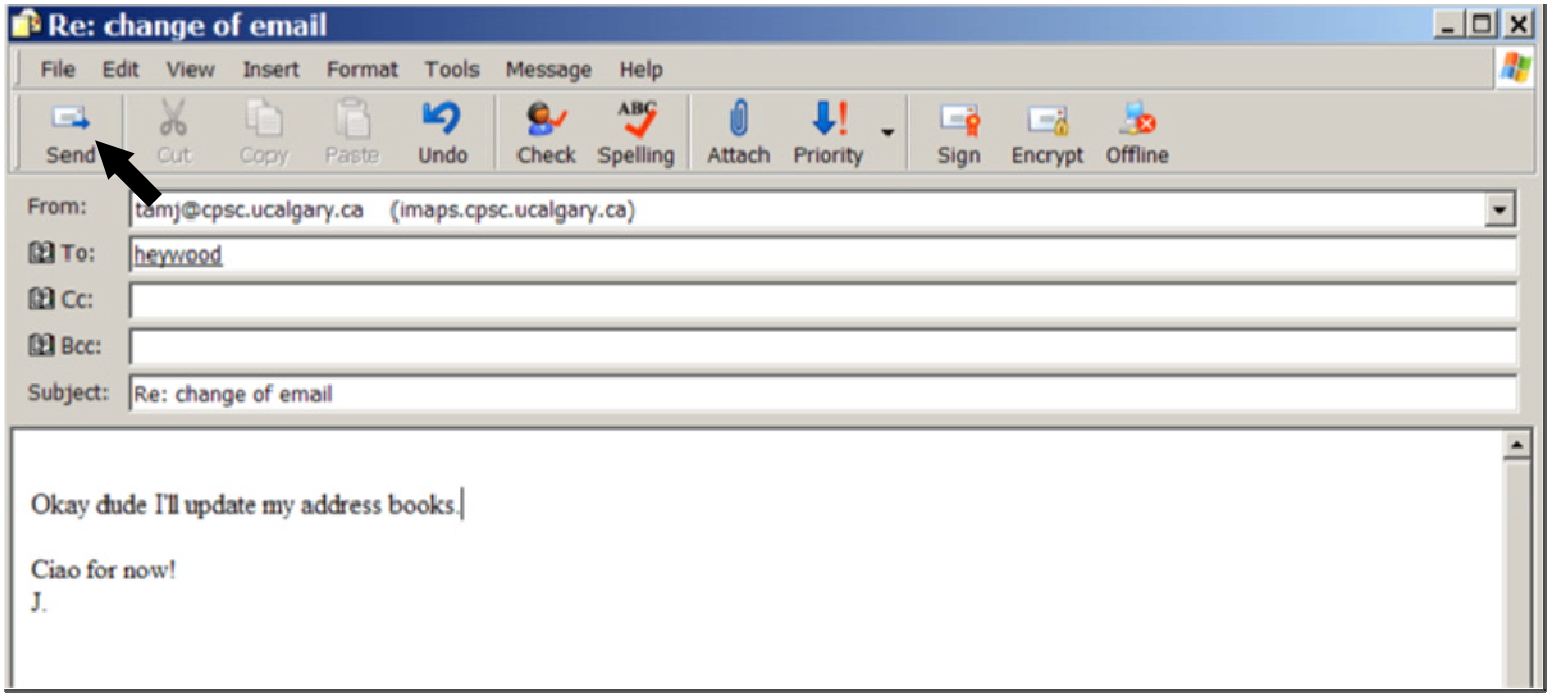
The thing that happens right after an action is assumed to be caused by that action

- Interpretation of “feedback”
- False causality
  - Incorrect effect



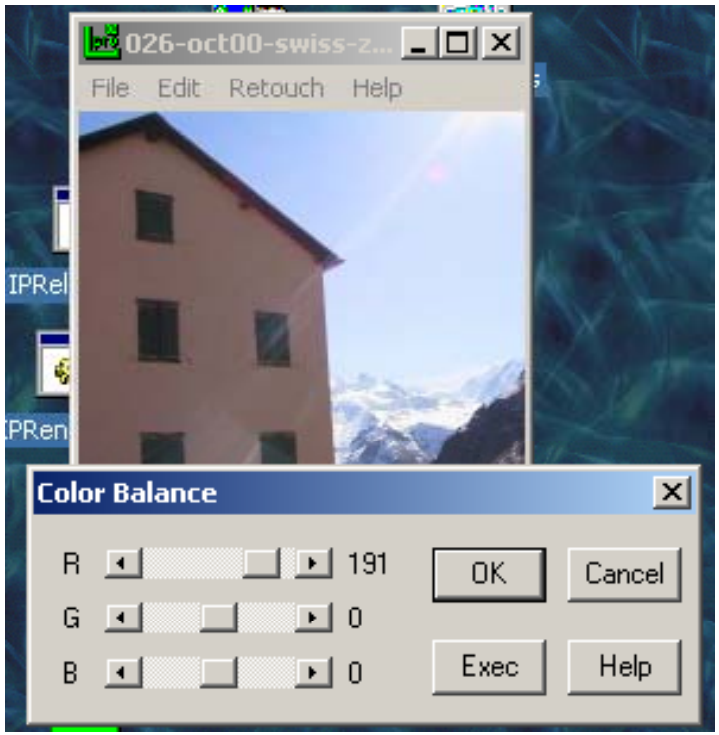
Causality

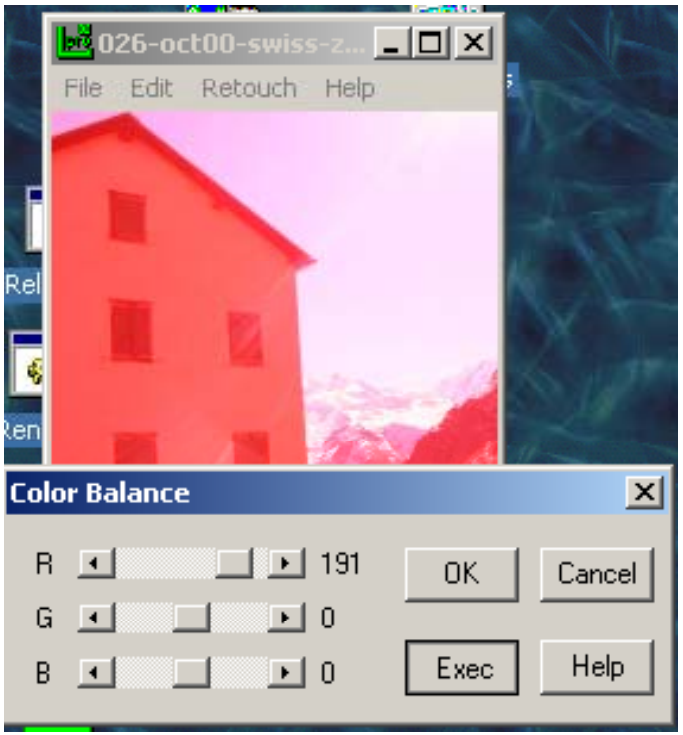
- Invisible effect



Lack Of Causality

- **No apparent cause-effect relation**
  - Ok does nothing!
  - Effects visible only after the “exe” button is pressed
- **Awkward to find appropriate color level**

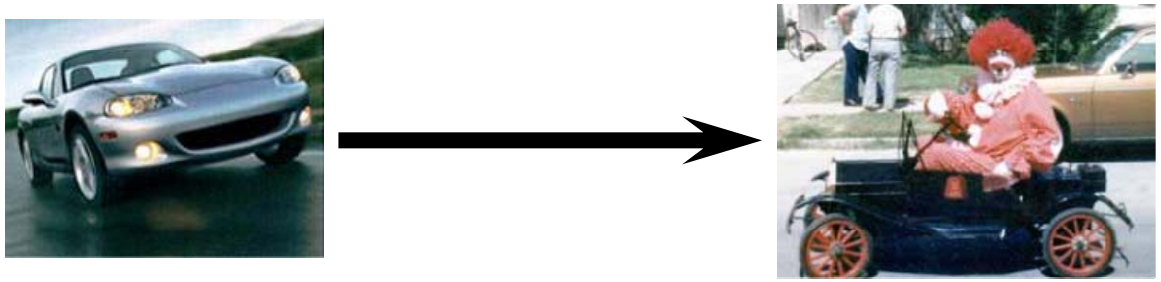




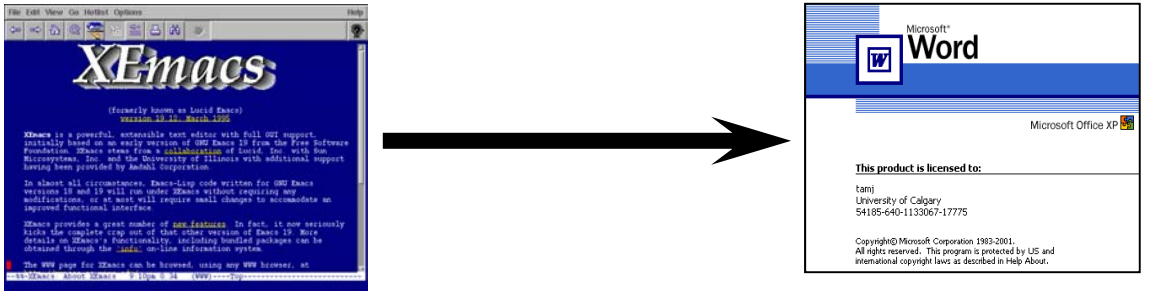
Transfer Effects

People transfer their learning/expectations of similar objects to the current object:

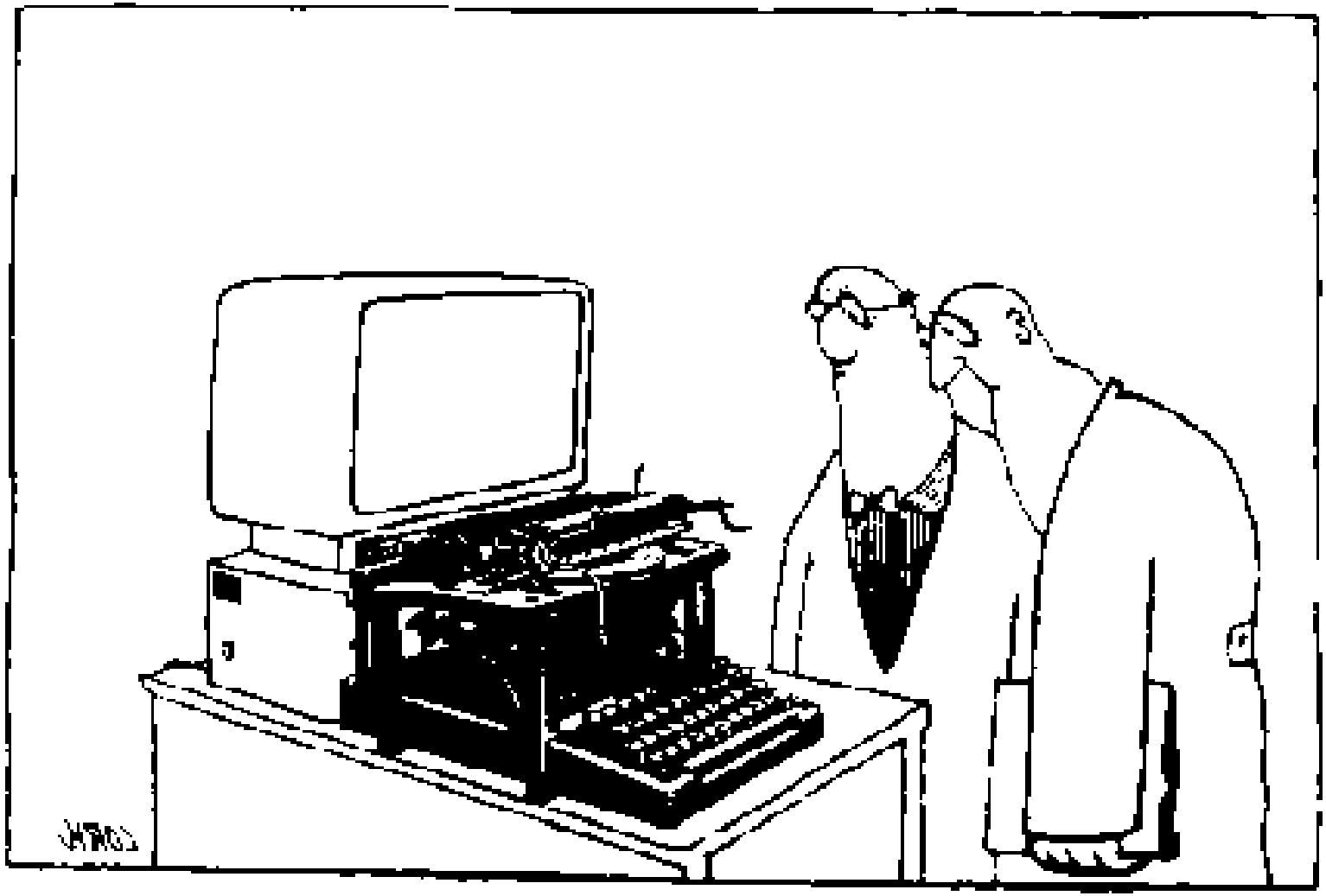
- Positive transfer



- Negative transfer



Transfer Effects



Population Stereotypes

Populations learn idioms that work in a certain way

- Red means danger
- Green means safe

- But idioms vary in different cultures!
  - Driving

    North America: drive on the right side of the road

    Europe: drive on the left side of the road

- Ignoring/changing stereotypes?
  - Calculators vs. phone number pads: which should computer keypads follow?

- Difficulty of changing stereotypes
  - Qwerty keyboard: designed to prevent jamming of keyboard
  - Dvorak keyboard (’30s): provably faster and more efficient to use

Cultural Associations And Icon Design

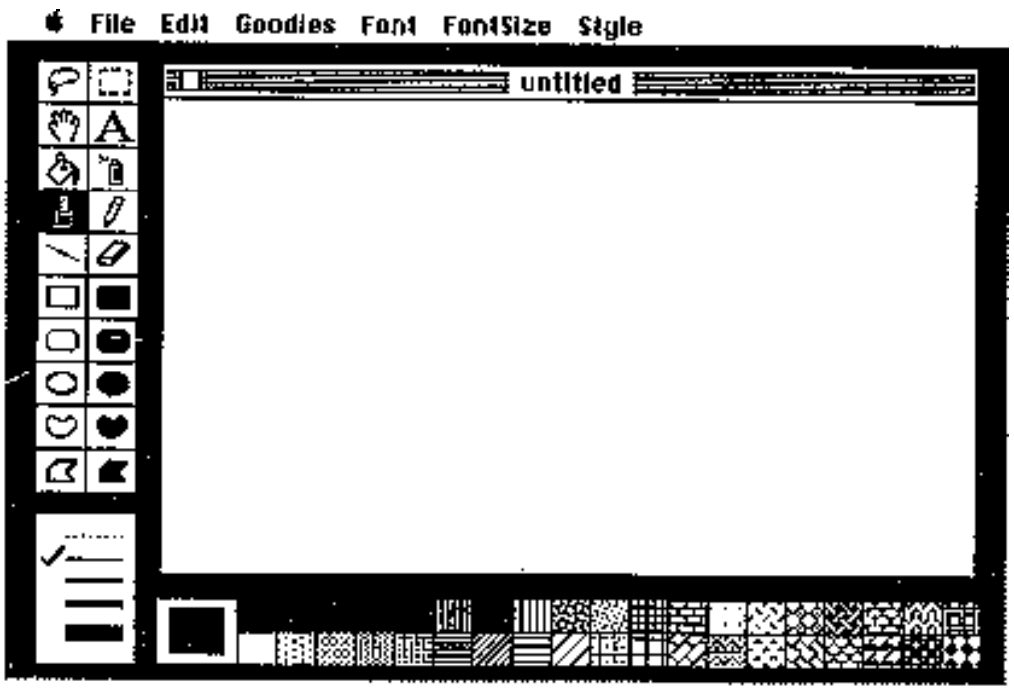
Because a trashcan in Thailand may look like this:

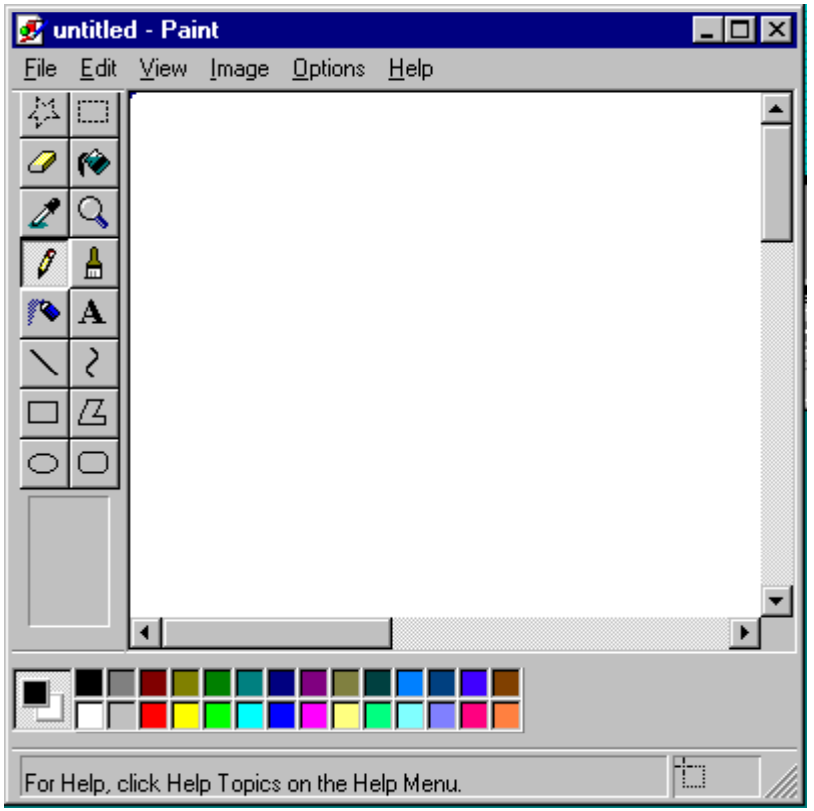
A Thai user is likely to be confused by this image popular in Apple interfaces:

Sun found their email icon problematic for some American urban dwellers who are unfamiliar with rural mail boxes.

Cultural Associations

A Mac user finds a Windows system only somewhat familiar





Individual Differences: Who Do You Design For?

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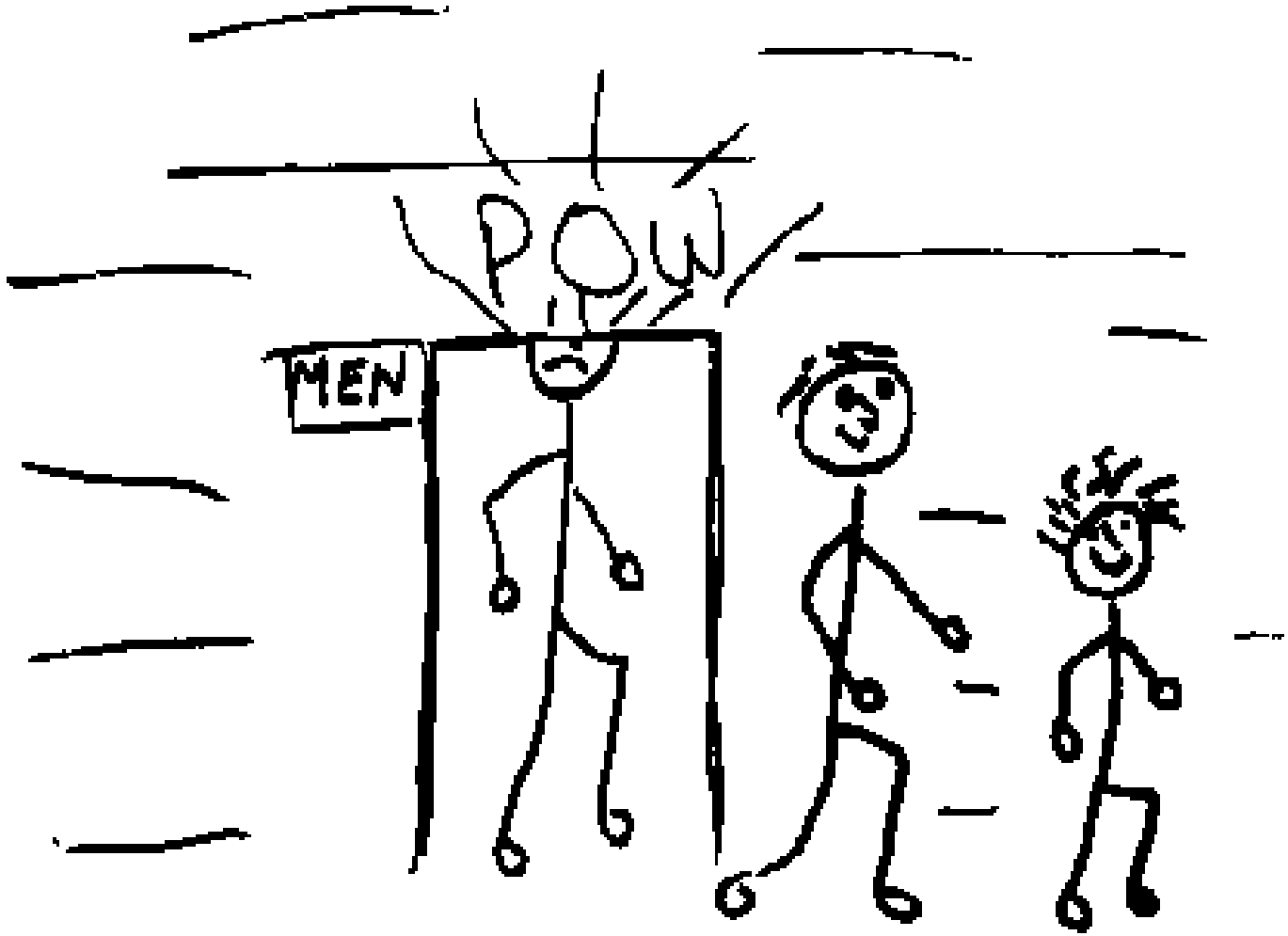


Individual Differences: Who Do You Design For?

People are different

It is rarely possible to accommodate all people perfectly

Rule of thumb:

- Designing for the average is a mistake
  - May exclude half the audience

- Design should cater for 95% of audience (ie for 5th or 95th percentile)
  - But means 5% of population may be (seriously!) compromised

Examples:

- Cars and height: headroom, seat size
- Computers and visibility:
  - Font size, line thickness, alternatives to color for color blind people?

Proverbs On Individual Differences

You do NOT necessarily represent a good representative user of equipment or systems you design.

Do not expect others to think and behave as you do, or as you might like them to.

People vary in thought and behaviour just as they do physically.

Who Do You Design For And Individual Differences

Computer users:

- Novices
  Walk up and use systems
  Interface affords restricted set of tasks
  Introductory tutorials to more complex uses
- Casual
  Standard idioms
  Recognition (visual affordances) over recall
  Reference guides
- Intermediate
  Advanced idioms
  Complex controls
  Reminders and tips
- Expert
  Shortcuts for power users
  Interface affords full task customization

most kiosk + internet systems

most shrink-wrapped systems

custom software

Why Design Is Hard

1) **The number of things to control has increased dramatically**

1950's – 1970's

1990's – 2000's

Why Design Is Hard (2)

2) Displays are sometimes overly abstract

- Red lights in car indicate problems vs. flames for fire

Why Design Is Hard (3)

3) Feedback can be more complex, subtle, and less natural

- Is your digital watch alarm on and set correctly?
- Is the phone in call forwarding mode?

4) Errors increasingly serious and/or costly

- Airplane crashes, losing days of work...

Why Design Is Hard (4)

…Costly errors:

From InfoWorld, Dec ’86

- “London—

An inexperienced computer operator pressed the wrong key on a terminal in early December, causing chaos at the London Stock Exchange. The error at [the stockbrokers office] led to systems staff working through the night in an attempt to cure the problem”

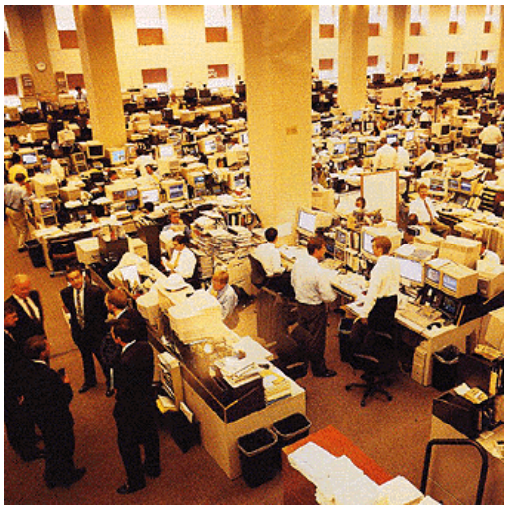


Image from the book “Wall Street” published by New York Distributors

Why Design Is Hard (5)

5) Marketplace pressures

- Adding functionality (complexity) now easy and cheap
  - Computers

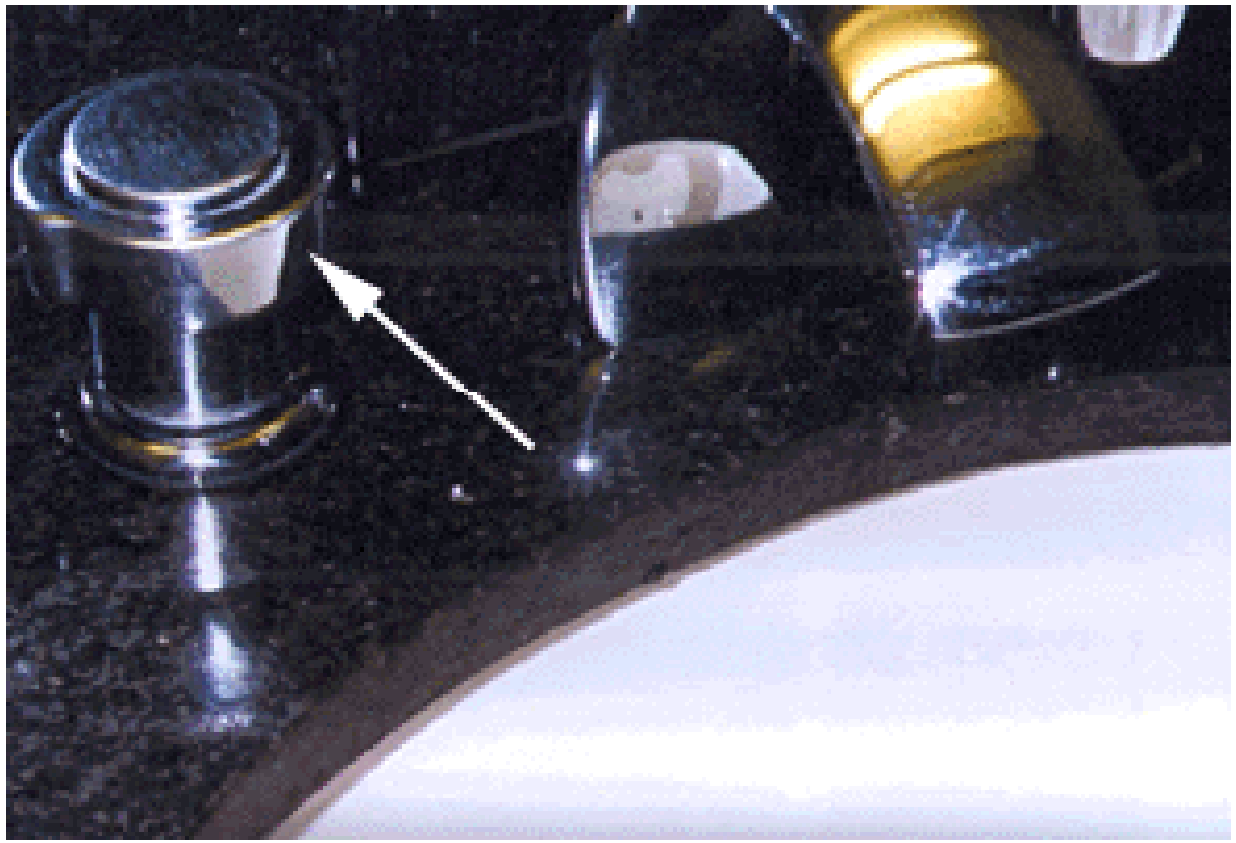
- Adding controls/feedback expensive
  - Physical buttons on calculators, microwave ovens
  - Widgets consume screen real estate

- Design usually requires several iterations before success
  - Product pulled if not immediately successful

Why Design Is Hard (5)

6) People often consider cost and appearance over designing with Human Factors in mind

- Bad design not always visible or obvious



www.baddesigns.com

Why Design Is Hard (6)

...Cost and appearance over Human Factors design

e.g., the wave of cheap telephones:

- Accidentally hangs up when button hit with chin
- Bad audio feedback
- Cheap pushbuttons—mis-dials common
- Trendy designs that are uncomfortable to hold
- Hangs up when dropped
- Functionality that can't be accessed (redial, mute, hold)

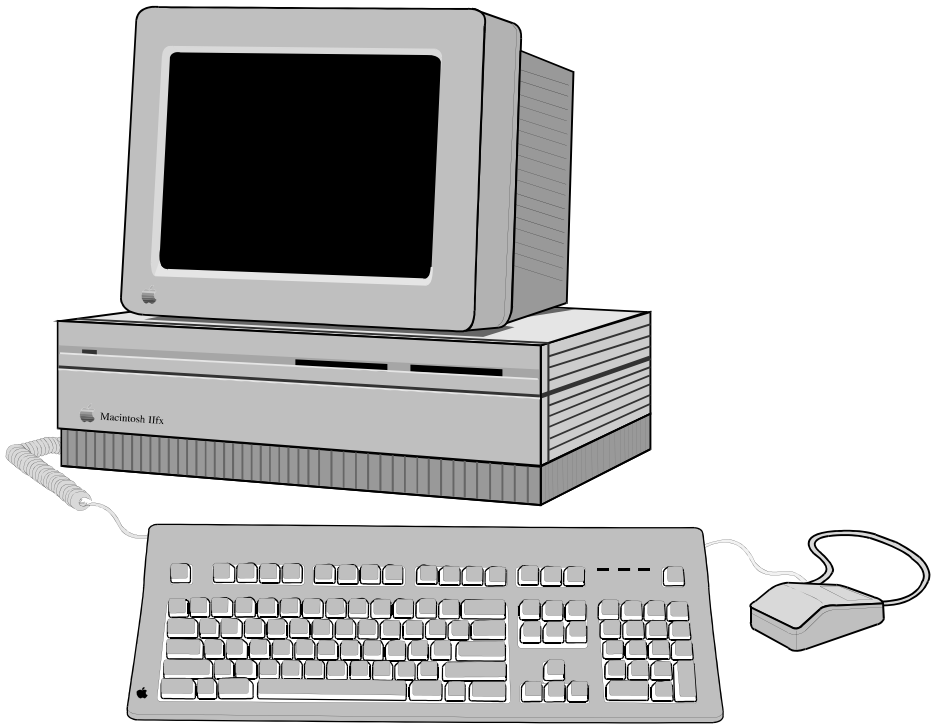
7) People tend to blame themselves when errors occur

- "I was never very good with machines"
- "I knew I should have read the manual!"
- "Look at what I did! Do I feel stupid!"

From "The Simspons"

Human Factors In The Design Of Computers

What does this do?



- Computers are far more complex to control than most physical devices
- General purpose computer contains no natural conceptual model
- Completely up to the designer to present a good model to the user

What You Know Now

Many so-called human errors are actually errors in design

- Don’t blame the user!

Designers help make things easier to use by providing a good conceptual model

- Affordances
- Constraints
- Mapping and causality
- Positive transfer
- Population stereotypes and cultural associations

Design to accommodate individual differences

- Decide on the range of users

Good design is difficult for a variety of reasons that go beyond design-related issues

Assignment for next week

- **Find a real world object with a design flaw**
- **Take a picture of the real world object**
- **Describe the design flaw(s)**